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Research Note

Compatibility Evaluation of Data Handling Subsystem

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METEOROLOGICAL DEVELOPMENT LABORATORY PROJECT 433L

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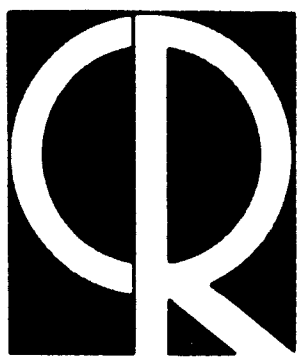

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METEOROLOGICAL DEVELOPMENT LABORATORY PROJECT 4338

AIR FORCE CAMBRIDGE RESEARCH LABORATORIES, OFFICE OF AEROSPACE RESEARCH, UNITED STATES AIR FORCE, L. G. HANSCOM FIELD, MASS.

Abstract

This report discusses an integrated high-speed data-handling subsystem designed to accommodate weather information. The subsystem utilizes standard telephone data circuits at speeds of 1000 through 2400 bits-per-second. The report indicates the results of an evaluation of equipments especially developed to accommodate the high-speed transmission function. These devices include:

a. A Master Control Station
b. A Data Selection Unit
c. Data Transmitters
d. Data Receivers

The proper equipment operation verifies the original design concept under which the data-handling system was developed.

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Compatability Evaluation of Data Handling Subsystem

1. INTRODUCTION

This report discusses the results of a series of tests conducted by the Meteorological Development Laboratory on a number of equipments originally designated as components of the overall 433L Air Force Weather Observing and Forecasting System. Only those tests conducted for purposes of verifying the compatibility of the component equipments are discussed, with an interpretation being made as to the applicability of test data to actual field operational conditions. Compatibility data of the type contained in this report are required by AFR 80-14 in Category I testing.

Many of the objectives of tests required by this regulation were met during the First Article Testing of the component equipments. Other objectives were met in non-compatibility type tests conducted by AFCRL and are not discussed in this report. The discussion is limited to tests conducted during the period of December 1960-April 1961, utilizing a Master Control Station.

This report is not to be construed as a Category I Test Report, since many of these tests are concerned with a mode of operation which is no longer characteristic of the System 433L Data Handling Subsystem. However, those data which pertain directly to the present system concepts can be extracted where necessary and applied to applicable system configurations. All tests were conducted with the approval and financial support of the System 433L Project Office in the interest of completing original development objectives.

(Authors' manuscript approved for publication, 1 November 1962)

2. SUMMARY AND CONCLUSIONS

This report provides data to indicate that all equipments tested could operate together as mated components without modification if utilized as part of a high-speed party line system as originally proposed for System 433L. The proper subsystem operation of these equipments under this operational mode verifies the original design concept from which the data-handling subsystem was developed. It does not necessarily demonstrate the adequacy of these equipments in all of the operational modes currently under consideration by System 433L.

3. DESCRIPTION OF DATA HANDLING SUBSYSTEM

3.1 Introduction

In October 1952 the Air Force Cambridge Research Center received approval from the Air Research and Development Command, USAF to initiate a research and development program in the area of weather data handling. The purpose of this program was to investigate new methods of meteorological data collection and dissemination within the operating organization of the Air Force and to implement in an actual system the results of this investigation. Initial work in this area consisted of efficiency studies of existing means for weather data transmission as well as detailed investigations of systems proposed for this purpose. In 1956 the Air Navigation Development Board requested the Bell Telephone Laboratories to initiate an engineering study of the existing weather data communication facilities and to propose an improved system of data collection and dissemination. This work is reported in a reference to this report.[1] These and other efforts of the Bell Telephone Laboratories, under the sponsorship of the Federal Aviation Agency and the Air Force Cambridge Research Center, are also discussed in a publication of the American Institute of Electrical Engineers.[2] In 1957 work was begun in the Atmospheric Devices Laboratory, Geophysics Research Directorate with the goal of developing a system incorporating the advantages outlined by the Bell work. These efforts resulted in a report published by the Atmospheric Devices Laboratory in 1957. This report[3] was widely circulated by the Air Force Cambridge Research Center and provided a general design for the entire Air Force Weather System 433L, including that portion of the System concerned with data handling. This report also served as a guide for Hermes Electronics Company, a contractor to the Air Force Cambridge Research Center, in the preparation of their detailed engineering design for the 433L Data Handling System.[4] Work has been continued in the data-handling area by the 433L System Project Office and by the United Aircraft

Corporation, a contractor to System 433L. However, these efforts have been concerned with the broad area of weather information transmission and almost no work has been done within the 433L System Project Office on a data-handling system utilizing the Bell Laboratories concept.

3.2 Data Handling System

The purpose of this section is to discuss the general design of the data handling system as evolved from the work referenced in the previous section. For clarity, the general design is presented in its broader aspects and no attempt has been made to include all details concerned with its proposed operation. The discussion, therefore, assumes a system of twenty-six stations, designated A, B, ... Y, Z, and a Master Control Station interconnected as shown in Figure 1. This diagram is presented for schematic purposes and as an outline of the data flow involved in the system.

With reference to Figure 1, the Master Control transmits a command on its send line for one station, Station A for example, to transmit its weather conditions. All of the stations, A, B, ... Y, Z, receive the command on their receive inputs but only station A produces an output on its send line. The output of station A is then received by the Master Control Station. If the proper station replied, let us assume – station A, to a request by the Master Control Station for station A to transmit, the Master Control will close its control gate (see Figure 1). The message will then pass to all other stations which may or may not be programmed to receive the message from station A. If stations B and Z, in Figure 1, are programmed to receive station A's message, they will receive this station's weather data. However, if station Y is not programmed to receive the message, it will bypass the data from station A. Upon completion of the transmission on its send line, the Master Control Station will open its control gate and send a command for the next station, in this case – station B, to transmit its weather message. This procedure will continue until all stations have transmitted.

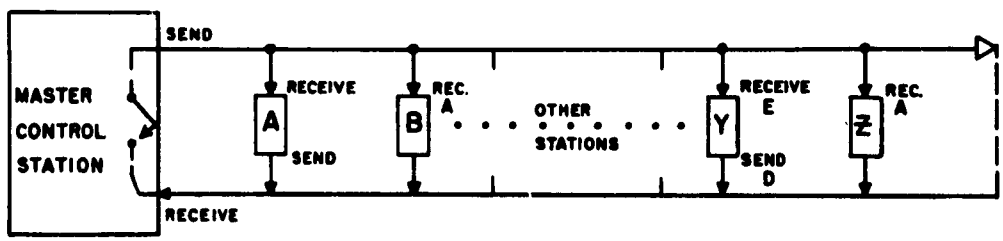

Figure 1. General Design of Data Handling Subsystem

Figure 2 shows a schematic diagram of the Master Control Station and two of the stations shown in Figure 1. In Figure 2 station A has the callup code of BED, which represents the weather station at Bedford, Massachusetts, while station Z has another callup code, XAA. The Master Control Station is programmed to transmit a callup list of hourly calls beginning exactly at the hour. This is indicated to the extreme left of Figure 2, with the two letters OA indicating that the Master Control Station is calling each of the other stations with a callup list that begins exactly on the hour. Initially, the Master Control Station sends the callup word OABED on its transmit line. At BED, the callup word enters the Control Monitor, a device that recognizes prestored callup words. The Control Monitor has in its memory the record indicated below the station code in Figure 2. It will turn on a transmitter to transmit its own station message upon receipt of the callup word OABED and it will receive a number of other calls beginning with OA. At BED the Control Monitor receives the callup word OABED, turns on its transmitter and then proceeds to transmit the BED message. This message, which begins with the letters OABED, passes down the line and is received by the Master Control Station. The Master Control Station then compares the first five letters of the message with its original callup word, OABED. If both are identical, the proper station has replied and the Master Control Station closes its "Gate", allowing the message from BED to be gated out on its transmit line. The message then passes to all other stations in the system. Various stations wish to receive BED's message and these have the callup word OABED stored in their memories. One of these is station XAA, as indicated in Figure 2. The message, therefore, enters the Control Monitor Station XAA, whereupon it passes to that station's receiver.

The Master Control Station then recognizes that the BED transmission has been completed and sends the next callup on its list. This procedure continues until the callup word OAXAA is sent. This callup word passes down the line to station XAA. The Control Monitor of station XAA recognizes that this station should

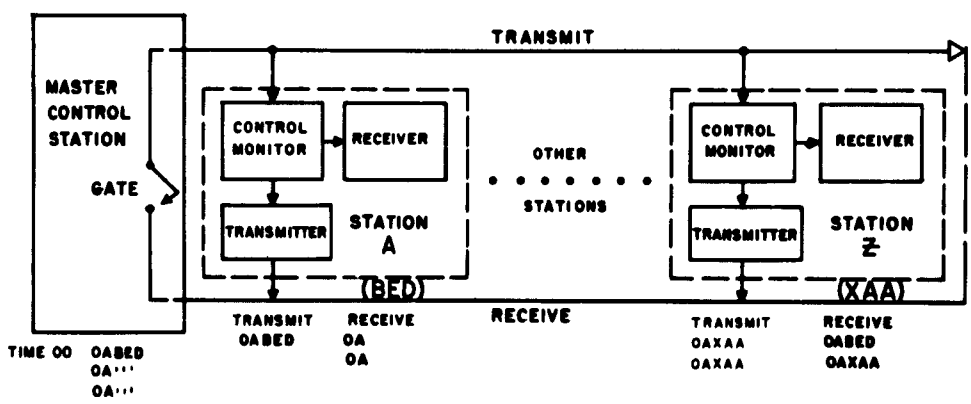

Figure 2. Schematic of Data Handling Subsystem

transmit its message, whereupon the XAA transmitter is turned on and the XAA message transmitted. This message passes to the Master Control Station which either accepts or rejects the message, as previously mentioned. If the message is accepted, the Master Control Station closes its "Gate" and the message passes to all stations in the system. Various stations wish to receive the XAA message and these have the callup word OAXAA stored in their memories. However, station BED is not one of these, as OAXAA is not one of the callup words listed under station BED in Figure 2. Station BED will, therefore, not receive the message from station XAA.

3.3 Transmission Schedule

The stations, as indicated in Figure 1, interchange data in a systematic manner following a predetermined schedule of transmissions. This schedule is designed to accommodate all station data requirements and can be determined only through a careful analysis of all data requirements. Once this analysis is made, a time appropriation can be established that accommodates, as best as possible, all requirements. For illustration purpose, in Figure 3 all types of digital data have been divided into four categories, designated A, B, C, and D. In addition, graphical data has been designated as type G. An assumption is made that all stations must transmit type A messages as part of a schedule beginning on each hour, and that all stations must also transmit type B messages as part of schedules beginning at 15, 30,and 45 minutes after the hour. Type C is assumed to be data that is transmitted as required, but may be selected in the presence of any other type of data. Type D data is special priority information and must be transmitted regardless of normal schedules. On the basis of these assumptions, Figure 3 has been assigned as a typical schedule for the data-handling system. Figure 3 contains the schedule for five hours of actual operation, with some of the type D data falling at time intervals during which particular special conditions exist. Note that the first type D transmission occurs at approximately 0023, at a time during which no data of another type is being transmitted. This particular transmission, therefore, causes no difficulty insofar as the transmission of data of another type is concerned. The second type D transmission, however, occurs at approximately 0047, at a time during which a type B transmission is in progress. The type B transmission is, therefore, interrupted for the time required by the type D data; and at time 0048, the type B data is resumed. The next type D transmission begins at 0129, at a time during which no data of another type is being

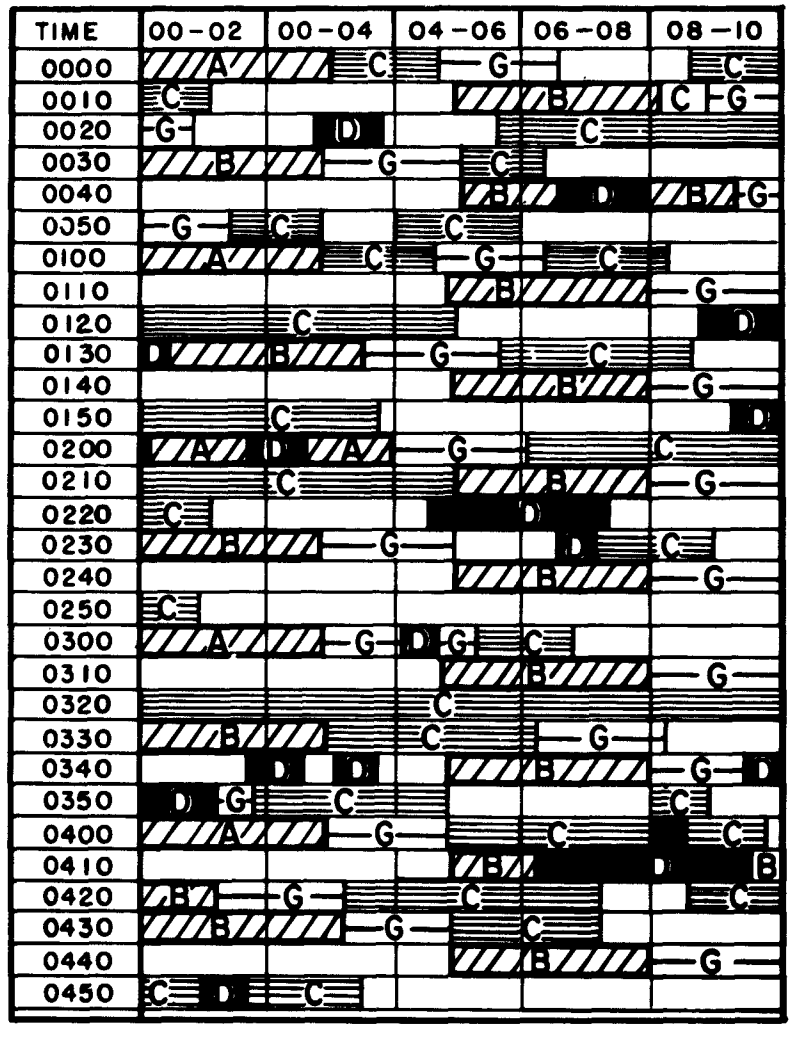

Figure 3. Typical Schedule for Data Handling Subsystem

transmitted. But since this type D transmission continues into the time of a normal type B transmission, the type B data is delayed. All other type D transmissions are combinations of these conditions.

3.4 Data Handling Equipments

In order to accomplish the functions, as indicated in Figure 2, a number of special purpose data-handling equipments were developed under the cognizance of

the Meteorological Development Laboratory, Air Force Cambridge Research Laboratories. These equipments have specific functions within the configuration of Figure 2 and are listed under the particular function as follows:

a. Master Control Station
   (1) Control Monitor C-2539( )/GTC
b. Control Monitor (also known informally as "SIFT")
   (1) Control Monitor AN/GGA-11
c. Transmitters
   (1) Semi-Automatic Telecode Transmitter AN/TMT-1( )
   (2) Telecode Distributor-Transmitter AN/GGT-2
   (3) Weatherplotter Transmitter (graphical data)
d. Receivers
   (1) Remote Electronic Alphanumeric Display AN/TMH-1
   (2) Teleprinter Set, Electrographic AN/GMH-2
   (3) Telecode Recorder, Electrographic AN/GTH-1
   (4) Weatherplotter Receiver (graphical data)

The operation of several of these equipments is presented in Appendix I and will not be discussed here. In addition to the specific equipments mentioned above, several auxiliary facilities are required. These are:

e. Schedule 4 data telephone line (communication)

f. Bell Digital Subsets (for connection of telephone line with Control Monitor and Transmitters, discussed above)

g. Teletype equipment (can be used for transmitting and receiving at 100 words per minute)

3.5 Individual Equipment Evaluation

Each of the equipments listed in section 3.4a through 3.4d above was tested and evaluated for proper operation as an independent communication device. This testing was accomplished, for the most part, by the contractor responsible for the development of each item. A formal test plan was required of the contractor in each case, and both the test plan and resulting test report were reviewed and approved by the Meteorological Equipment Development Laboratory, Air Force Cambridge Research Laboratories. The test reports on these devices indicated, after all necessary equipment redesign and modification, that each device would operate satisfactorily as an independent unit. In addition tests were, in most cases, conducted at extremes of power input, temperature, humidity and pressure, indicating that these equipments could be expected to operate satisfactorily in environments that would be encountered during normal equipment operation. In addition, all equipments were subjected to a period of sustained operation under

normal room ambient conditions. This period of operation usually lasted thirty days; although in some cases, forty-two days of testing were required. Moreover, error rate tests were conducted on each device, in cases where such testing was feasible. Additional information on these tests may be obtained from the Meteorological Development Laboratory, Air Force Cambridge Research Laboratories.

3.6 Data Handling System Evaluation

Two separate evaluation programs of the data-handling system have been completed to date. The first of these was conducted during the summer of 1960 and involved several of the data-handling equipments listed in section 3.4. The communication facility utilized in these tests was a 1000-mile-long length of standard data telephone line, extending from Bedford to St. Louis, Missouri. The line was interconnected end-to-end at St. Louis so that the total line length, Bedford to St. Louis and return, was 2000 miles. Several tests were conducted over this facility with the prime purpose of evaluating the prototype Control Monitor AN/GGA-11. A report of the Geophysics Research Directorate[5] discusses these tests in detail and indicates that the Control Monitor can be expected to satisfactorily perform its function as outlined in section 3.2. It should also be noted that, although the primary purpose of this program was to evaluate the Control Monitor, various transmitters and receivers used as test equipments were, in themselves, evaluated for satisfactory system operation.

The second system evaluation program was a more comprehensive series of tests and was conducted during the period of 5 December 1960-1May 1961. These tests, which are the subject of the remainder of this report, include a Master Control Station, which was located at Hartford, Connecticut and a simulated local station, located at Bedford, Massachusetts. The Bedford station was equipped with a number of transmitters and receivers and specific tests were performed to verify the proper system operation of these equipments. Section 5 to this report contains the specific tests performed as part of this program; the tests results indicate that the common-line high speed data-handling system can be expected to operate satisfactorily with high reliability and low error rates.

4. GENERAL TEST OUTLINE

The outline contained in this section was prepared in October 1960 and is presented here to serve as a guide to the tests contained in this section.

Outline of Compatibility Test for Data Handling Subsystem

I. PURPOSE

The purpose of this test program is to evaluate the compatibility of member components of the Data Handling Subsystem, as required by AFR 80-14.

II. EQUIPMENTS TO BE TESTED

A. The following equipments will be used in the Test Program:

1. Control Monitor C-2539 (Master Control)
2. Control Monitor C-2538 (SIFT)
3. High Speed Transmitters: TMT-1, T-684 (as available)
4. High Speed Receivers: TMH-1, GMH-2, RO-92 (as available)
5. Schedule 4 Telephone Data Line, Bedford to Hartford and Hartford to Bedford
6. Bell Digital Subsets (MODEMS)
7. Teletype transmitters and receivers
8. Tapes from Fenske, Federick and Miller Weatherplotter

III. TEST PLAN-GENERAL STATEMENT

The various equipments will be connected to the Schedule 4 data line, which will run from Bedford to Hartford, Connecticut. The Master Control will be tied to the Hartford end of the line and the Control Monitors C-2538 will be tied to the Bedford terminal (two models of the SIFT equipment are available – the Control Data Corporation version of CDC-SIFT and the Burroughs SIFT). Initially, the equipment will operate at 75 baud with teletype equipment; however, as high speed receivers become available, the speed will be increased to 750 baud. At the present time, it is not anticipated that the operating speed will exceed 750 baud although, if time permits, testing will be performed at 2400 baud, using Stromberg-Carlson SC-200 modems (to be loaned by Stromberg-Carlson).

IV. DURATION OF THE TESTING PROGRAM

Testing will begin on or about 5 December 1960 on a limited basis, and will terminate when all scheduled tests are completed (no later than April 1961).

Outline of Compatibility Test for Data Handling Subsystem (Cont.)

V. TEST PLAN

A. Testing will be divided into two schedules:

1. Master Control Tests*

Each morning from 0830 to 1130 a program will be run on the Master Control with the major objective being the testing of this unit.

2. Test of Other Equipments

Each afternoon from 1300 to 1600 a program will be run on the Master Control with the major objective being the testing of SIFT, the transmitters and the receivers. This program will, of necessity, differ from the program mentioned in step 1 above.

If one of the above tests is completed prior to the other, the daily schedule will be altered to allow for programming of the uncompleted test only.

B. The Master Control Test

1. Procedure

The Master Control will send various formats of priority I, II, and III callups. The SIFT and a TMT-1 will be modified in order to provide a reply to these calls, regardless of their formats. Routines will be tested for such contingencies as broken lines, interrupted transmissions, etc.

2. Coordination

It should be noted that coordination will be required between Bedford and Hartford, both at specific time intervals and as required by breakdowns, etc. A telephone will be available as a part of the digital subset for this purpose.

3. Reports

Logs will be kept both at Bedford and at Hartford, and all malfunctions, errors, etc., will be recorded.

C. Test of Other Equipment

1. Procedure

The Master Control will send the callups of only a limited number of stations, since only one station may reply (Bedford).

* In actuality, no Master Control Tests were conducted due to programming and time limitations. However, these tests are listed in Appendix II for purposes of information and completeness.

Outline of Compatibility Test for Data
Handling Subsystem (Cont.)

Also, the Master Control will, through a printed tape input, simulate transmissions of other stations. These transmissions will be used to test the SIFT and the receivers.

2. Coordination

It should be noted that coordination will be required between Bedford and Hartford, both at specific time intervals and as required by breakdowns, etc.

3. Reports

Logs will be kept, both at Bedford and at Hartford, and all malfunctions, errors, etc., will be recorded.

VI. DUTIES OF PERSONNEL

A. At Bedford:

1. It will be necessary for personnel at Bedford to prepare the general outline for the tests of equipments located at Reservoir Hill. This outline will be used by United Aircraft Corporation in writing a program for the Master Control.

2. It will be necessary for personnel at Bedford to modify all equipments, construct all "stunt boxes", interconnect all units and perform all duties required at Reservoir Hill in order to begin the Test Program.

3. It will be necessary for one technician to be available for full time duty at Bedford during the course of the program.

B. At Hartford:

1. It will be necessary for personnel at Hartford to write the program and schedule for the Master Control Test.

2. It will be necessary for personnel at Hartford to write the program for the Test of Other Equipments, after receiving a test outline from Bedford.

3. It will be necessary for one engineer, or high level technician or programmer, to be available at Hartford for about two hours each day plus daily standby during normal working hours.

VII. AVAILABILITY OF TEST RESULTS

Periodic reports will be made to System 433L SPO concerning any deficiencies within Data Handling Subsystem equipment. In this way, difficulties within the System 433L Test Network may be anticipated.

5. TEST DATA

The details of all tests are discussed in Appendix II. This Appendix outlines all proposed tests, any revisions made necessary during testing and results of those tests which were actually performed.

6. INTERPRETATION OF TEST RESULTS

In general, the testing program indicated that a compatible subsystem may be expected to result from the mating of the various equipments. The difficulties encountered during the testing program, together with an explanation of their effect upon the over-all subsystem compatibility, are tabulated below:

a. Tests 1 and 2: The difficulties encountered during these tests were of a nature of "shake-down" exercises or equipment malfunction.

b. Test 4: Equipment malfunction.

c. Test 6: Programming of Master Control.

d. Test 7: Programming of Master Control and "Modem" or Dataphone Set difficulties.

e. Tests 8 and 9: These tests could not be performed due to lack of a second operational Control-Monitor AN/GGA-11.

f. Test 10: Programming of Master Control and Control-Monitor malfunction.

g. Test 11. A limited simulation of the subsystem was used in place of a full simulation due to the unavailability of the Master-Control and the AN/GMH-2 concurrently.

h. Tests 14 and 15: A limited simulation of the subsystem was used in place of a full simulation due to the unavailability of the Master-Control and AN/GMH-2 concurrently.

i. Test 16: Equipment malfunction.

j. Test 17: Equipment malfunction.

An analysis of these difficulties indicates that with the availability of reliable service test equipment in place of the prototypes used in several portions of the testing programs, long-term compatible operation may be expected from the various subsystem components.

7. RECOMMENDATIONS

Recommendations are as follows:

a. Further testing should be performed, utilizing the Control Monitor C-2539 at Hartford, Connecticut to insure the compatibility of the AN/GGA-11 and

AN/GMH-2 with other items of System equipment. These tests should also include Test Nos. 50-57 in Appendix II.

b. Diode control gates should be installed on the outputs of the Control Monitor to prevent erroneous triggering of transmitters or receivers.

Appendix I

1. DESCRIPTION OF EQUIPMENT TESTED

1.1 Control Monitor C-2539 (Master Control)

The Control Monitor C-2539( )/GTC controls the initiation of message transmission over a high-speed data communication facility according to a predetermined transmission schedule which is subject to change when necessary. The Control Monitor also recognizes certain types of failures, and applies necessary corrective action to maintain transmission schedules, and records these failures and the remedial action taken.

1.2 Control Monitor AN/GGA-11 (SIFT)

The Control Monitor AN/GGA-11 , shown in Figure 4, consists of two major components: a distributor and a selector. The distributor converts the incoming serial telecode to parallel character code and, in turn, transmits information to the selector. The selector controls the operation of transmitters and receivers at the station in accordance with the received signals.

In the receiver control function, the readout device is selected in accordance with the programmed requirements of the local station. In the transmitter control function, the Control Monitor initiates the transmission to the network after recognizing the station callup and required message signal.

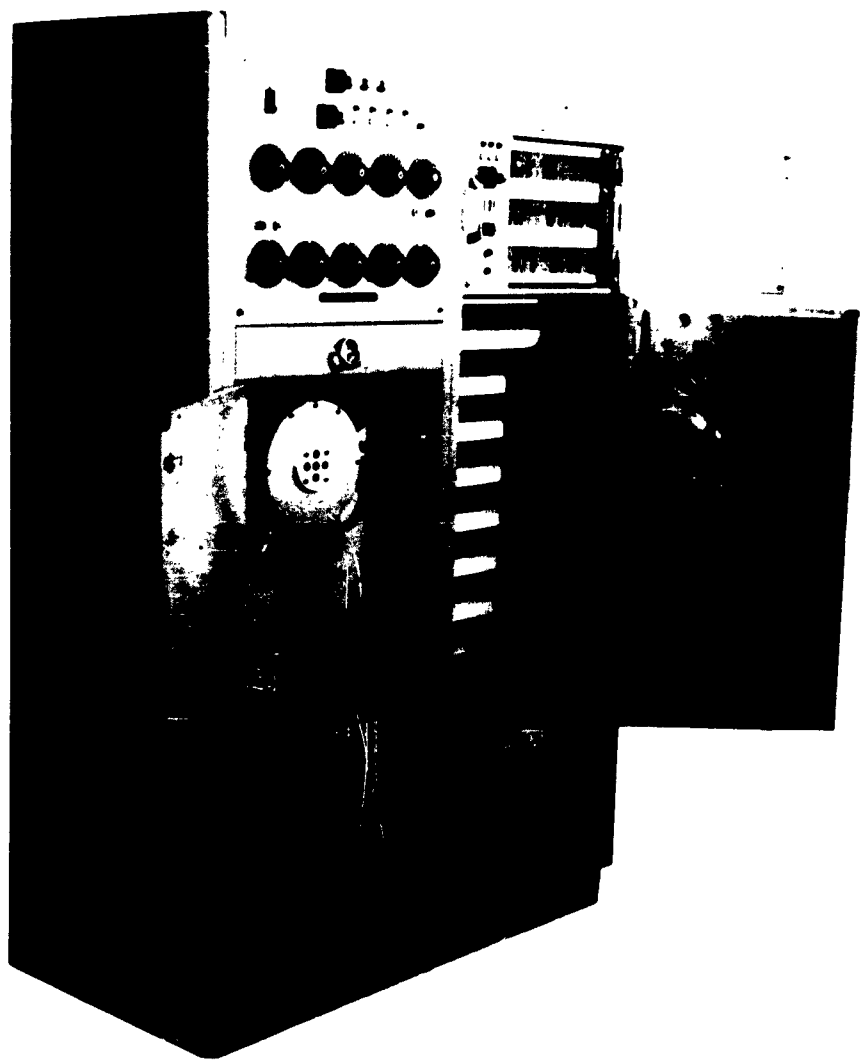

Figure 4. Control Monitor AN/GGA-11

1.3 Semi-Automatic Telecode Transmitter AN/TMT-1( )

The Semi-Automatic Telecode Transmitter AN/TMT-1( ), shown in Figure 5, is a manually operated message encoder. Seventy-two movable character slides are used to set up the message. The transmitter is capable of transmitting either fixed format messages or special messages to the long lines or teletypewriter circuits at selected speeds.

1.4 Meteorological Data Display Set AN/TMH-1( )

The Meteorological Data Display AN/TMH-1( ) (READ) consists of a converter and an indicator. The converter receives weather data in telecode and converts it to parallel character code to drive the indicator. The indicator may be located within fifty feet of the converter. By an electrographic printing technique, an erasable record of the message is displayed on a continuous tape. As many as ten display sets may be driven by a single weather data transmitter over standard telephone lines.

1.5 Digital MODEM

The Digital MODEM is a communications network signal-conditioning transceiver. The MODEM transmitter converts a train of direct current bits of digital information into alternating current signals suitable for handling by conventional types of long telephone transmission lines. The MODEM receiver interprets these carrier current signals so as to reproduce the digital bits in their original form for further processing. The transmitting and receiving components are combined into one unit to take advantage of common components. A digital MODEM is used at every input/output "drop" of the transmission circuit.

1.6 Electrographic Teleprinter AN/GMH-2 (WHIPPET)

The AN/GMH-2, shown in Figure 6, is a high-speed electrographic line printer that can work directly from a telephone line and provide a display of data passing on the line. The printer can operate at speeds from 75 baud to 2400 baud, and each line of data may have as many as 72 characters.

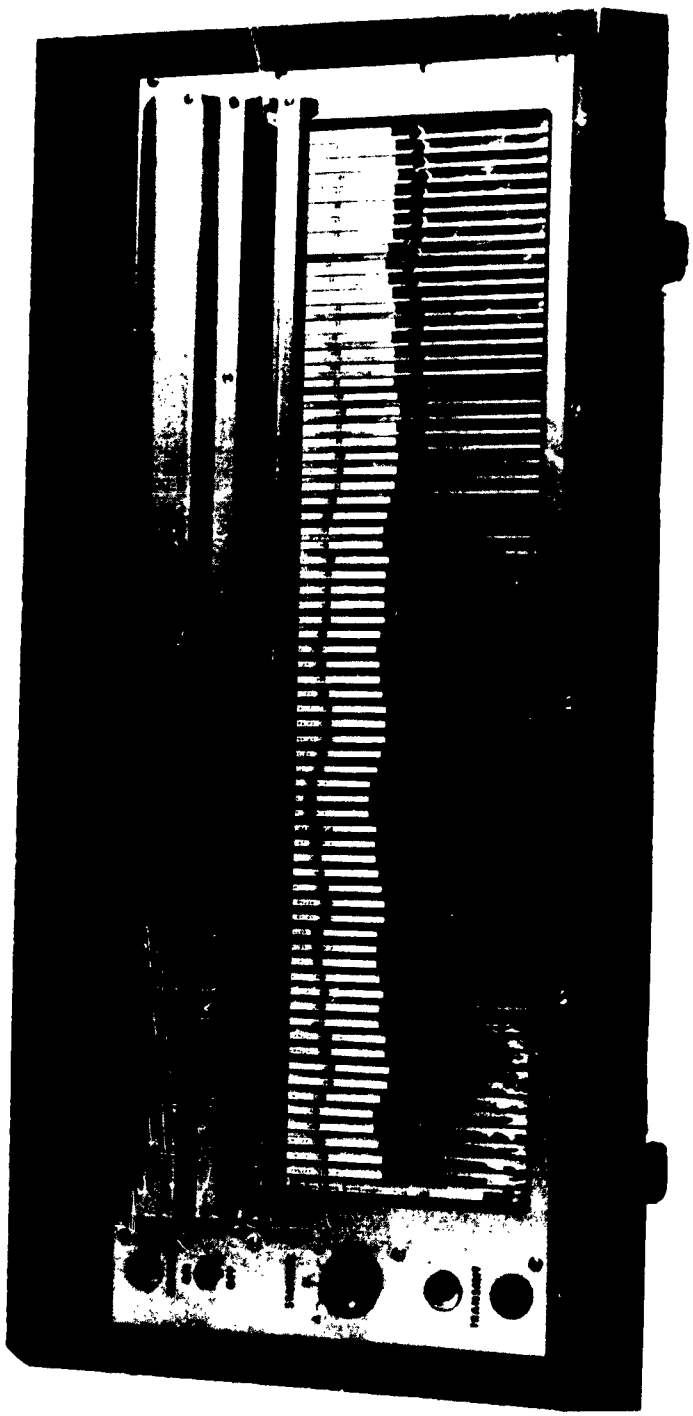

Figure 5. Semi-Automatic Telecode Transmitter AN/TMT-1

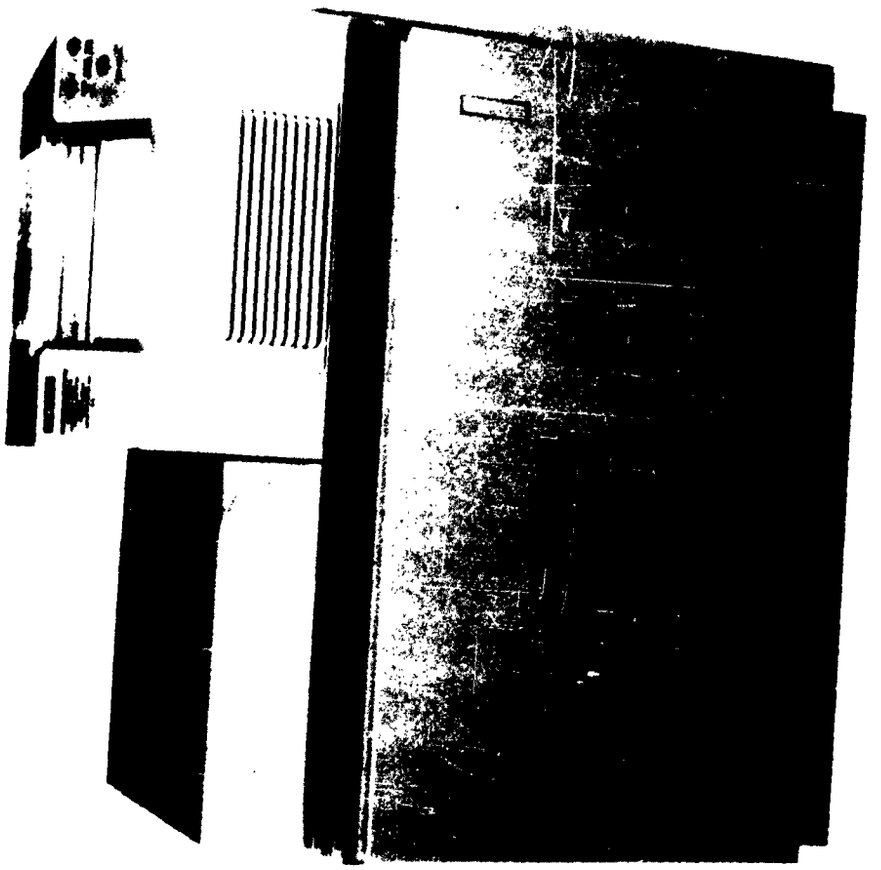

Figure 6. Electrographic Recorder AN/GMH-2

During AN/GMH-2 operation, serial data from the communications line enters a distributor which provides parallel output signals for each character. The character information is next fed to dot decoders which form a dot-type matrix for each character. The decoded signals are then directed to a row of 72 electrostatic character heads which charge a special paper as it passes through a bath of graphite ink and picks up the ink only in those areas that have been properly charged. The result is a highly readable record of the data passing on the telephone line.

1.7 Weatherplotter Transmitter and Receiver

At the transmitter, a pointer is used by an operator to trace data from a chart or map. This data punches paper tape at the same time as the operator traces the map. The paper tape is then read on a reader out onto a communications circuit.

At the receiving end, the data coming over the communications line is used to punch a second paper tape which is then placed on another tape reader. This reader feeds the data to a control and plotting system which etches the map on a small slide. The slide is then placed into a projector and the map displayed.

Appendix II

1. TESTS AND TEST RESULTS

This section discusses the tests conducted during the testing program. The following test schedule should be noted:

a. Tests 1-9 were conducted at a speed of 75 baud.

b. Tests 10-17 were conducted at a speed of 750 baud.

c. Tests 50-57 were conducted primarily to test the Master Control unit.

1.1 Test 1

1.1.1 PROCEDURE

a. The Master Control sends a callup list and simulates the replies of stations to this list.

b. SIFT is connected to a teletype through a black box ("or" gate) and receives only the messages that it is programmed to receive.

c. The callup list and replies, provided by the Master Control, should consist of one hundred callup words. In this case, a tape may be used as the input device, with the delays between messages being controlled by the Master Control.

d. This test is initially performed with the Burroughs SIFT*; however, the

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* The Control Monitor referred to here was a prototype 100 callup word memory device.

CDC SIFT* may be used when it is installed, requiring the repetition of this test.

1.1.2 RESULTS

On 30 December 1960, Hartford attempted to transmit the Test 1 program. The data that was received at Bedford was five times the desired rate and indicated that the Master Control was malfunctioning. From 31 December 1960 to 9 January 1961, Bedford remained at a standby status to assist Hartford in isolating the trouble in the Master Control. On 9 January 1961, Hartford transmitted the Test 1 format and it was received correctly at Bedford. Two minor changes were made in Test 1 format at the request of Bedford. On 10 January 1961 three complete programs of Test 1 format were transmitted and received correctly, thus ending Test 1.

Test 1 Program Format

The Master Control sent the following callup list with simulated replies for each callup. Bedford was programmed to receive every other callup starting with RDBED, and reject the others.

Callup List	Message Proper	End of Message
RDBEA RDBEA	ABCDE	CR LF Fig S
RDBED RDBED	ABCDE	CR LF Fig S
RDWAC RDWAC	ABCDE 12345	CR LF Fig S
RDAAC RDAAC	ABCDE 12345	CR LF Fig S
RDABC RDABC	12345 ABCDE 67890	CR LF Fig S
RDMMM RDMMM	12345 ABCDE 67890	CR LF Fig S
RDMAB RDMAB	ABCDE 12345 FGHLJ 67890	CR LF Fig S
RDXYZ RDXYZ	ABCDE 12345 FGHLJ 67890	CR LF Fig S
RDCZA RDCZA	12345 ABCDE 67890 FGHLJKLMNO	CR LF Fig S
RDCSS RDCSS	12345 ABCDE 67890 FGHLJKLMNO	CR LF Fig S

* CDC SIFT is a service test Control Monitor with a 1000 callup word memory built by Control Data Corporation.

Test 1 Program Format (Cont.)

Callup List	Message Proper	End of Message
UCBEA UCBEA	ABCDE	CR LF Fig S
UCBED UCBED	ABCDE	CR LF Fig S
UCWAC UCWAC	ABCDE 12345	CR LF Fig S
UCAAC UCAAC	ABCDE 12345	CR LF Fig S
UCABC UCABC	12345 ABCDE 67890	CR LF Fig S
UCMMM UCMMM	12345 ABCDE 67890	CR LF Fig S
UCMAB UCMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
UCXYZ UCXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
UCCZA UCCZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
UCCSS UCCSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
MBBEA MBBEA	ABCDE	CR LF Fig S
MBBED MBBED	ABCDE	CR LF Fig S
MBWAC MBWAC	ABCDE 12345	CR LF Fig S
MBAAC MBAAC	ABCDE 12345	CR LF Fig S
MBABC MBABC	12345 ABCDE 67890	CR LF Fig S
MBMMM MBMMM	12345 ABCDE 67890	CR LF Fig S
MBMAB MBMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
MBXYZ MBXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
MBCZA MBCZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
MBCSS MBCSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
OABEA OABEA	ABCDE	CR LF Fig S
OABED OABED	ABCDE	CR LF Fig S
OAWAC OAWAC	ABCDE 12345	CR LF Fig S
OAAAC OAAAC	ABCDE 12345	CR LF Fig S
OAABC OAABC	12345 ABCDE 67890	CR LF Fig S
OAMMM OAMMM	12345 ABCDE 67890	CR LF Fig S
OAMAB OAMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
OAXYZ OAXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
OACZA OACZA	12345 ABCDE 67890 FGHIHKLMNO	CR LF Fig S
OACSS OACSS	12345 ABCDE 67890 FGHIHKLMNO	CR LF Fig S

Test 1 Program Format (Cont.)

Callup List	Message Proper	End of Message
FABEA FABEA	ABCDE	CR LF Fig S
FABED FABED	ABCDE	CR LF Fig S
FAWAC FAWAC	ABCDE 12345	CR LF Fig S
FAAAC FAAAC	ABCDE 12345	CR LF Fig S
FAABC FAABC	12345 ABCDE 67890	CR LF Fig S
FAMMM FAMMM	12345 ABCDE 67890	CR LF Fig S
FAMAB FAMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
FAXYZ FAXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
FACZA FACZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
FACSS FACSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
GEBEA FEBEA	ABCDE	CR LF Fig S
GEBED GEBED	ABCDE	CR LF Fig S
GEWAC GEWAC	ABCDE 12345	CR LF Fig S
GEAAC GEAAC	ABCDE 12345	CR LF Fig S
GEABC GEABC	12345 ABCDE 67890	CR LF Fig S
GEMMM GEMMM	12345 ABCDE 67890	CR LF Fig S
GEMAB GEMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
GEXYZ GEXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
GECZA GECZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
GECSS GECSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
HDBEA HDBEA	ABCDE	CR LF Fig S
HDBED HDBED	ABCDE	CR LF Fig S
HDWAC HDWAC	ABCDE 12345	CR LF Fig S
HDAAC HDAAC	ABCDE 12345	CR LF Fig S
HDABC HDABC	12345 ABCDE 67890	CR LF Fig S
HDMMM HDMMM	12345 ABCDE 67890	CR LF Fig S
HDMAB HDMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
HDXYZ HDXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
HDCZA HDCZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
HDCSS HDCSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S

Test 1 Program Format (Cont.)

Callup List	Message Proper	End of Message
ACBEA ACBEA	ABCDE	CR LF Fig S
ACBED ACBED	ABCDE	CR LF Fig S
ACWAC ACWAC	ABCDE 12345	CR LF Fig S
ACAAC ACAAC	ABCDE 12345	CR LF Fig S
ACABC ACABC	12345 ABCDE 67890	CR LF Fig S
ACMMM ACMMM	12345 ABCDE 67890	CR LF Fig S
ACMAB ACMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
ACXYZ ACXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
ACCZA ACCZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
ACCSS ACCSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
CEBEA CEBEA	ABCDE	CR LF Fig S
CEBED CEBED	ABCDE	CR LF Fig S
CEWAC CEWAC	ABCDE 12345	CR LF Fig S
CEAAC CEAAC	ABCDE 12345	CR LF Fig S
CEABC CEABC	12345 ABCDE 67890	CR LF Fig S
CEMMM CEMMM	12345 ABCDE 67890	CR LF Fig S
CEMAB CEMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
CEXYZ CEXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
CECZA CECZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
CECSS CECSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
DBBEA DBBEA	ABCDE	CR LF Fig S
DBBED DBBED	ABCDE	CR LF Fig S
DBWAC DBWAC	ABCDE 12345	CR LF Fig S
DBAAC DBAAC	ABCDE 12345	CR LF Fig S
DBABC DBABC	12345 ABCDE 67890	CR LF Fig S
DBMMM DBMMM	12345 ABCDE 67890	CR LF Fig S
DBMAB DBMAB	ABCDE 12345 FGHIJ 67890	CR LF Fig S
DBXYZ DBXYZ	ABCDE 12345 FGHIJ 67890	CR LF Fig S
DBCZA DBCZA	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S
DBCSS DBCSS	12345 ABCDE 67890 FGHIJKLMNO	CR LF Fig S

1.2 Test 2

1.2.1 PROCEDURE

a. The Master Control sends a callup list consisting of the calls of Test 1, with one exception. For the BED calls, the Master Control does not simulate the reply, nor is the reply of any other station simulated. For this test, the following format is used:

RDBEA (wait three seconds for reply)
RDBED (wait three seconds and verify reply) (Message may be eight seconds long)
RDWAC (wait three seconds for reply)
ETC.

b. The Master Control must verify that the BED station replies to the proper calls only. A log should be kept of errors.

c. This test may be repeated on the CDC-SIFT.

1.2.2 RESULTS

Beginning 11 January 1961, Bedford made the necessary gating arrangements to turn on the AN/TMT-1 when the proper callup words were received by SIFT (see Figure 4). Hartford started programming the Master Control for Test 2. Test 2 was attempted the following day, but trouble developed in the Master Control line buffer. From 13 January to 26 January 1961, Bedford remained in a standby status while Hartford made some wiring changes in the line buffer that were found to be in error. On 27 January 1961, Test 2 program was transmitted to Bedford where it was received correctly. In addition to the Test 2 program, the period 27-30 January 1961 was spent checking out the Master Control's ability to recognize the "no reply", "wrong station" reply, and "message too long" reply. The Master Control performed this function satisfactorily. At the conclusion of these tests, Test 2 was considered completed.

Test 2 Program Format

The Master Control transmitted the following callup words without simulated replies. A 3-second delay between each callup word was programmed in for verification of replies. Bedford was programmed to reply to all BED callup words. As there are only six transmitter enable controls, the program format included only the first six groups of callup words used in Test 1.

Test 2 Program Format (Cont.)

Callup Test	Message Proper	End of Message
RDBEA	ABCDE	CR LF Fig S
RDBED RDBED		CR LF Fig S
RDWAC		CR LF Fig S
RDAAC		CR LF Fig S
RDABC		CR LF Fig S
RDMMM		CR LF Fig S
RDMAB		CR LF Fig S
RDXYZ		CR LF Fig S
RDCZA		CR LF Fig S
RDCSS		CR LF Fig S
UCBEA		CR LF Fig S
UCBED UCBED	ABCDE	CR LF Fig S
UCWAC		CR LF Fig S
UCAAC		CR LF Fig S
UCABC		CR LF Fig S
UCMMM		CR LF Fig S
UCMAB		CR LF Fig S
UCXYZ		CR LF Fig S
UCCZA		CR LF Fig S
UCCSS		CR LF Fig S
MBBEA		CR LF Fig S
MBBED	ABCDE	CR LF Fig S
MBWAC		CR LF Fig S
MBAAC		CR LF Fig S
MBABC		CR LF Fig S
MBMMM	ABCDE	CR LF Fig S
MBMAB		CR LF Fig S
MBXYZ		CR LF Fig S
MBCZA		CR LF Fig S
MBCSS		CR LF Fig S

Test 2 Program Format (Cont.)

Callup List	Message Proper	End of Message
OABEA		CR LF Fig S
OABED OABED	ABCDE	CR LF Fig S
OAWAC		CR LF Fig S
OAAAC		CR LF Fig S
OAABC		CR LF Fig S
OAMMM		CR LF Fig S
OAMAB		CR LF Fig S
OAXYZ		CR LF Fig S
OACZA		CR LF Fig S
OACSS		CR LF Fig S
FABEA		CR LF Fig S
FABED FABED	ABCDE	CR LF Fig S
FAWAC		CR LF Fig S
FAAAC		CR LF Fig S
FAABC		CR LF Fig S
FAMMM		CR LF Fig S
FAMAB		CR LF Fig S
FAXYZ		CR LF Fig S
FACZA		CR LF Fig S
FACSS		CR LF Fig S
GEBEA		CR LF Fig S
GEBED GEBED	ABCDE	CR LF Fig S
GEWAC		CR LF Fig S
GEAAC		CR LF Fig S
GEABC	ABCDE	CR LF Fig S
GEMMM		CR LF Fig S
GEMAB	ABCDE	CR LF Fig S
GEXYZ		CR LF Fig S
GECZA		CR LF Fig S
GECSS		CR LF Fig S

1.3 Test 3

1.3.1 PROCEDURE

a. The Master Control sends various callups, but only BED replies. The BED transmission is verified by the Master Control and gated back to BED, which receives the information.

b. The program as used by the Master Control should be identical to the above test, except that the information is gated back to the BED station.

c. This test may be repeated on the CDC SIFT.

1.3.2 RESULTS

On 1 February 1961, Bedford made the program for Test 3. No difficulties were encountered during Test 3 and it was completed on 2 February 1961.

Test 3 Program Format

Test 3 Program Format was identical to Test 2 with two exceptions:
a. The message that Bedford transmitted was gated through the Master Control back to Bedford where it was received on a teletype.
b. The message proper was changed to include the entire alphabet.

1.4 Test 4

1.4.1 PROCEDURE

a. The Master Control sends a callup list and simulates the replies of all stations on the list except BED. For BED the Master Control sends only the proper call.

b. SIFT is connected to a teletypewriter and receives only the messages it is programmed to receive. A transmitter is connected to SIFT to reply to the BED calls, with a message of five characters. In this case, the Master Control logs the transmission and retransmits the message back to BED.

c. This test may be repeated with the CDC SIFT.

1.4.2 RESULTS

The necessary changes in equipment at Bedford were completed on 3 February 1961 while Hartford was completing the programming. A malfunction of the SIFT occurred at the end of the day. The period of 6 February to 8 February 1961 was

spent trouble shooting the SIFT. The trouble was temporarily corrected by using the callup station selector switches in the lower fifty switch blocks. Test 4 was then completed.

Test 4 Program Format

The Master Control transmitted the following callups word list with simulated replies for all stations except Bedford. For Bedford, the Master Control sent only the callup words RDBED, UCBED, etc. Bedford was programmed to reply only to these-- BED calls. The Bedford reply was gated through SIFT to the receiving teletype. The Bedford SIFT was also programmed to receive the callups with their simulated replies as indicated by an asterisk (*).

Callup List	Message Proper	End of Message
RDBEA		Ltr CR LF Fig S
RDBED RDBED	ABCDE	Ltr CR LF Fig S
RDWAC		Ltr CR LF Fig S
* RDAAC RDAAC	ABCDE 12345	Ltr CR LF Fig S
RDABC		Ltr CR LF Fig S
* RDMMM RDMMM	12345 ABCDE 67890	Ltr CR LF Fig S
RDMAB		Ltr CR LF Fig S
* RDXYZ RDXYZ	ABCDE 12345 FGHIJ 67890	Ltr CR LF Fig S
RDCZA		Ltr CR LF Fig S
* RDCSS	12345 ABCDE 67890 FGHIJKLMNO	Ltr CR LF Fig S
UCBEA		Ltr CR LF Fig S
UCBED UCBED	ABCDE	Ltr CR LF Fig S
UCWAC		Ltr CR LF Fig S
* UCAAC UCAAC	ABCDE 12345	Ltr CR LF Fig S
UCABC		Ltr CR LF Fig S
* UCMMM UCMMM	12345 ABCDE 67890	Ltr CR LF Fig S
UCMAB		Ltr CR LF Fig S
* UCXYZ UCXYZ	ABCDE 12345 FGHIJ 67890	Ltr CR LF Fig S
UCCZA UCCZA		Ltr CR LF Fig S
* UCCSS UCCSS	12345 ABCDE 67890 FGHIJKLMNO	Ltr CR LF Fig S

Test 4 Program Format (Cont.)

Callup List	Message Proper	End of Message
MBBEA		Ltr CR LF Fig S
MBBED MBBED	-ABCDE	Ltr CR LF Fig S
MBWAC		Ltr CR LF Fig S
* MBAAC MBAAC	ABCDE 12345	Ltr CR LF Fig S
MBABC		Ltr CR LF Fig S
* MBMMM MBMMM	12345 ABCDE 67890	Ltr CR LF Fig S
MBMAB		Ltr CR LF Fig S
* MBXYZ MBXYZ	ABCDE 12345 FGHIJ 67890	Ltr CR LF Fig S
MBCZA		Ltr CR LF Fig S
* MBCSS MBCSS	12345 ABCDE 67890 FGHIJKLMNO	Ltr CR LF Fig S
OABEA		Ltr CR LF Fig S
OABED OABED	-ABCDE	Ltr CR LF Fig S
OAWAC		Ltr CR LF Fig S
* OAAC OAAC	ABCDE 12345	Ltr CR LF Fig S
OAABC		Ltr CR LF Fig S
* OAMMM OAMMM	12345 ABCDE 67890	Ltr CR LF Fig S
OAMAB		Ltr CR LF Fig S
* OAXYZ OAXYZ	ABCDE 12345 FGHIJ 67890	Ltr CR LF Fig S
OACZA		Ltr CR LF Fig S
* OACSS OACSS	12345 ABCDE 67890 FGHIJKLMNO	Ltr CR LF Fig S
FABEA		Ltr CR LF Fig S
FABED FABED	-ABCDE	Ltr CR LF Fig S
FAWAC		Ltr CR LF Fig S
* FAAAC FAAAC	ABCDE 12345	Ltr CR LF Fig S
FAABC		Ltr CR LF Fig S
* FAMMM FAMMM	12345 ABCDE 67890	Ltr CR LF Fig S
FAMAB		Ltr CR LF Fig S
* FAXYZ FAXYZ	ABCDE 12345 FGHIJ 67890	Ltr CR LF Fig S
FACZA		Ltr CR LF Fig S
* FACSS FACSS	12345 ABCDE 67890 FGHIJKLMNO	Ltr CR LF Fig S

Test 4 Program Format (Cont.)

Callup List	Message Proper	End of Message
GEBEA		Ltr CR LF Fig S
GEBED GEBED	-ABCDE	Ltr CR LF Fig S
GEWAC		Ltr CR LF Fig S
* GEAAC GEAAC	ABCDE 12345	Ltr CR LF Fig S
* GEMMM GEMMM	12345 ABCDE 67890	Ltr CR LF Fig S
GEMAB		Ltr CR LF Fig S
* GEXYZ GEXYZ	ABCDE 12345 FGHIJ 67890	Ltr CR LF Fig S
GECZA		Ltr CR LF Fig S
* GECSS GECSS	12345 ABCDE 67890 FGHIJKLMNO	Ltr CR LF Fig S

1.5 Test 5

1.5.1 PROCEDURE

Test 5 is identical to Test 3 except that Bedford replies with a Weatherplotter tape, the data from which is received and used as the input to the Weatherplotter receiver.

1.5.2 RESULTS

Preparations for Test 5 were begun 10 February 1961 by both Bedford and Hartford. A switch circuit was designed and constructed so that the SIFT unit could remotely turn the teletype transmitter on and off. This switching circuit was required because the teletype transmitter is normally controlled manually. Several short messages were transmitted with the teletype transmitter using a tape from the FF & M Weatherplotter. During this test, a second Weatherplotter tape transmitted a message which was looped back to Bedford. This message, a map of the United States, was over six minutes in duration at 100 word/min. This completed Test 5.

Test 5 Program Format

The Master Control transmitted the callup list of Test 2. Bedford was programmed to reply, using a teletype transmitter with Weatherplotter tape, only to -- BED callup words. These replies were gated through the Master Control back to Bedford where they were recorded on a receiving teletype

Test 5 Program Format (Cont.)

printer. The replies that Bedford transmitted were as follows:

RDBED ABCDE

UCBED ABCDE 12345

MBBED ABCDE 12345 FGHIJ

OABED ABCDE 12345 FGHIJ 67890

FABED ABCDR 12345 FGHIJ 67890 KLMNO

GEBED ABCDE 12345 FGHIJ 67890 KLMNOPQRST

At the conclusion of the above program, the Master Control transmitted RDBED, and Bedford replied with a six-minute Weatherplotter tape. This reply, a map of the United States, was gated through the Master Control back to Bedford where it was received on a receiving teletype.

1.6 Test 6

1.6.1 PROCEDURE

a. The Master Control transmits the callup words of Test 1.

b. The two TMT-1's are arranged to reply with two different message types: RDBED, UCBED, MBBED and OABED: and FABED and GEBED.

c. The Master Control verifies the proper transmission and logs any errors. The message is then transmitted back to the SIFT, where two teletypewriters receive the message data.

1.6.2 RESULTS

On 17 February 1961, preparations for Test 6 were started. At Bedford, three gating circuits were required for this test. These gating circuits were as follows:

a. An arrangement of diodes was connected to the SIFT transmit control output to control AN/TMT-1( ) number 1 and number 2.

b. A diode network was connected to the receiver output channels of SIFT to insure the following operation. When the proper callup message triggers the AN/TMT-1 number 1, the transmitted message is looped back to Bedford, through SIFT, and printed out on teletype number 1. The same operation occurs for AN/TMT-1 number 2 and the transmitted message is printed out on teletype number 2.

c. Protective diodes were inserted in the AN/TMT-1 lines to prevent interaction.

The Test 6 program was first transmitted to Bedford on 20 February 1961. Part of the Bedford replies that were gated back went to the wrong receiving teletypes. This was corrected by having the "End of Message" that followed each -- BED callup word removed.

Test 6 was completed without further trouble on 21 February 1961.

Test 6 Program Format

The Master Control transmitted the callup word list of Test 2. Bedford was programmed to reply using two transmitters; one to reply to the first four -- BED calls and the other to reply to the last two -- BED calls. The Master Control then looped these replies back to Bedford where two teletypewriters were wired to print them out. (Teletype number 1 printing TMT number 1 output, and teletype number 2 printing TMT number 2 output.)
The two transmitter control gates were arranged as follows:

TMT number 1 replies to: RDBED, UCBED, MBBED, and OABED

TMT number 2 replies to: FABED and GEBED

They were arranged in this manner to insure operation with the Burroughs SIFT, because the remote receivers are wired as follows:

Remote Receiver number 1: R and U
Remote Receiver number 2: M and O
Remote Receiver number 3: F, G, and H
Remote Receiver number 4: A, C, and D

Since the Master Control has no EOM programmed after BED calls, the call which triggers the transmitter also "opens the receiver gate" for that callup. Example: RDBED is received by Bedford and is programmed on transmitter channel number 1 of SIFT to enable a transmitter. It is also programmed to enable a receiver and since "R" is wired to enable remote receiver number 1, the receiver is left in a ready state.

The replies that Bedford transmitted were as follows:

TMT number 1	TMT number 2
RDBED ABCDE	FABED ABCDE
UCBED ABCDE	GEBED ABCDE
MBBED ABCDE	
OABED ABCDE	

Test 6 Program Format (Cont.)

Teletypewriter number 1 was wired to remote receiver numbers 1 and 2.
Teletypewriter number 2 was wired to remote receiver number 3.

1.7 Test 7

1.7.1 PROCEDURE

a. The Master Control transmits the callup words of Test 1, simulating all replies except for BED.

b. Two TMT-1's are arranged to reply with one answering only RDBED calls and the other answering all other BED calls.

c. The Master Control verifies the proper transmission and logs any errors. The message or simulated message is then transmitted to the SIFT where one teletype prints the RD messages only, and the other teletype prints all other messages.

1.7.2 RESULTS

On 22 February 1961, preparations for Test 7 were started. A gating arrangement for controlling the AN/TMT-1's and for controlling receiver outputs from the SIFT was completed. Test 7 program was transmitted the following day, but found to be unsatisfactory. Hartford had to re-program the Test 7 format as they did not allow enough time between callups for Bedford to reply. Hartford again tried to transmit Test 7 program but trouble with the schedule number 4 data line occurred. The telephone company was called and asked to trouble shoot the line. On 27 February 1961, the telephone company called and informed us that the trouble we were experiencing was caused by the low baud rate used in the set tests. In conclusion, the telephone company informed us that in order to solve the problem, the MODEM frequency would have to be changed. As Test 7 was the last test that could perform at 75 baud due to a lack of a second SIFT at Bedford, it was decided to terminate the 75 baud tests and go directly to the main phase tests.

1.8 Test 8*

1.8.1 PROCEDURE

a. The Bedford station is arranged with two SIFTS representing two different stations: BED (CDC SIFT) and AAC (BUR SIFT).

* Test 8 was not performed due to the reasons mentioned in Test 7 results. The procedures are listed for continuity of record only.

b. Master Control sends a program similar to Test 3, except that BED and AAC must respond. The Master Control logs any errors, and then gates the information back to Bedford.

c. BED and AAC receive only the information that they are programmed to receive.

d. The messages transmitted by BED and AAC will vary in content and length, as required by Test 1 format.

1.9 Test 9*

1.9.1 PROCEDURE

a. The Master Control sends a callup list and simulates the replies of all stations on the list (Test 1), except BED and AAC. For BED and AAC, the Master Control sends only the proper call.

b. Two SIFTS are connected to teletypewriters and receive only the messages that they are programmed to receive. TMT-1's are connected to SIFT's in order to reply to the BED calls and to the AAC calls (the BED message is five characters and the AAC message is ten characters). In each case, the Master Control logs the replies and retransmits the messages back to Bedford.

1.10 Test 10

1.10.1 PROCEDURE

a. The Master Control sends a callup list and simulates the replies of stations on this list.

b. SIFT is connected to a high-speed receiver, READ, through an "or" gate and receives only those messages that it is programmed to receive (only the BED calls) for visual checking of READ.

c. The callup list and replies provided by the Master Control is shown in Test 1. In this case, a tape may be used as the input device, with the Master Control storing the replies and reading them out of memory upon call.

1.10.2 RESULTS

On 3 March 1961, Hartford attempted to transmit the Test 10 program. On the first attempt, two difficulties were encountered: Bedford SIFT did not reject the

* Test 9 was not performed due to the reasons mentioned in Test 7 results. The procedures are listed for continuity of record only.

unwanted messages and Hartford was transmitting with no time delay between callups. (This did not allow READ enough time to recover to a "ready" state between calls.) The period 3 March 1961 through 6 March 1961 was spent correcting these problems. Hartford programmed a 1.2 second time delay between callups. This allowed "READ" 12 seconds to recover between -- BED calls (Paper Take-up), which was sufficient. On the Bedford end, the malfunction in SIFT was located and corrected. Transistor Q6 of J33 (end of message card) had to be replaced. Test 10 format was transmitted and received properly on 6 March 1961. This test was repeated several times without difficulty, thus ending Test 10.

Test 10 Program Format

Test 10 Program Format was identical to Test 1 with these exceptions:

a. The test was run at 750 baud.
b. The AN/TMH-1 (READ) was used as a receiver.
c. Bedford was programmed to receive only -- BED calls.
d. A 1.2 second delay between callups was programmed in the Master Control to allow READ time to read out and return to a "ready" state. (This gave READ 12 seconds between BED calls, which was sufficient.)

1.11 Test 11

1.11.1 PROCEDURE

Test 11 is identical to Test 10 except that an AN/GMH-2 is used in place of the READ. The result is that a staircase copy is obtained through sifting of every other callup word.

1.11.2 RESULTS

It was not possible to perform the test indicated above since the AN/GMH-2 was not available at the same time as the Master Control. However, in July 1961 the following test was performed in lieu of the prescribed procedure.

a. An AN/TMT-1 is used to simulate both the Master Control and the replying station transmitter. The AN/TMT-1 is set up with the following data (EOM signifies "End of Message" Code); EOM OBBED ERROR ERROR ERROR EOM OABED TEST OF CONTROL MONITOR.

b. The AN/TMT-1 signal output is sent over a simulated telephone line to a Control Monitor AN/GGA-11 Service Test model, with the callup OABED in its memory. An AN/GMH-2 is connected to the proper output from the AN/GGA-11 for purposes of receiving data. The AN/GMH-2 script will indicate the text "TEST OF CONTROL MONITOR" if a correct selection has been accomplished, and the text "ERROR ERROR ERROR" if an incorrect selection has been made. During the July 1961 tests, the Control Monitor was modified to accept a "6" in place of upper case S as the End of Message (EOM) code. This was necessary since the AN/TMT-1 could transmit upper case S only once during an AN/TMT-1 transmission and it was necessary to transmit the End-of-Message code several times. Also, modification was accomplished in the Control Monitor distributor to allow for proper input timing. After this was accomplished, a total of 40,880 callup words and messages were transmitted and received without error.

Test 11 Program Format

Test 11 Program Format was run at 750 baud with an AN/GMH-2 as the receiver. No delay, other than that provided by the AN/TMT-1 was utilized. The timing modification and EOM change necessitated the insertion on the AN/TMT-1 of the following format:

6 OBBED-ERROR ERROR ERROR	6 OABED-TEST OF CONTROL MONITOR

The "-" symbol previous to the message data was used to synchronize the output of the Control Monitor after a selection had been made. The resulting data had the following format:

6-TEST OF CONTROL MONITOR
6-TEST OF CONTROL MONITOR
6-TEST OF CONTROL MONITOR
(ETC.)

1.12 Test 12

1.12.1 PROCEDURE

a. The Master Control sends a callup list consisting of the calls of Test 2 with one exception. For BED calls the Master Control does not simulate the reply, nor is the reply of any other station simulated. For this test the following format is used:

RDBEA (wait 0.3 seconds for reply)
RDBED (wait 0.3 seconds and verify reply) (Messages may be 0.8 seconds long)
RDWAC (wait 0.3 seconds for reply)
ETC.

b. The Master Control must verify that the BED station replies to the proper calls only. A log should be kept of errors.

c. This test may be repeated on the CDC SIFT.

1.12.2 RESULTS

On 7 March 1961, the necessary arrangements were made to perform Test 12, which was successfully concluded. This test was the same as Test 2 except that it was run at 750 baud.

Test 12 Program Format

Test 12 Program Format was identical to Test 2 except that it was run at 750 baud.

1.13 Test 13

1.13.1 PROCEDURE

a. The Master Control sends various callup words, but only BED replies. The BED transmission is verified by the Master Control and gated back to BED which receives the message on READ.

6. The program as used by the Master Control should be identical to the

above test, except that the information is gated back to the BED station.

c. This test may be repeated on the CDC SIFT.

1.13.2 RESULTS

Test 13 was also started on 7 March 1961. No difficulties were encountered and it was concluded on 8 March 1961. This test was the same as Test 3 except that the test was performed at 750 baud, and "READ" was used as a receiver.

Test 13 Program Format

Test 13 Program Format was identical to Test 3 with these exceptions:
a. The test was run at 750 baud.
b. The AN/TMH-1 was used as a receiver.

1.14 Test 14*

This test is identical to Test 13, except that a script is printed out on the GMH-2.

1.15 Test 15*

1.15.1 PROCEDURE

a. The Master Control sends a callup list and simulates the replies of all stations on the list (Test 1) except for BED. For BED, the Master Control sends only the proper call.

b. SIFT is connected to a GMH-2 and receives only the messages that it is programmed to receive. A transmitter is connected to SIFT to reply to the BED calls, with a message of five characters. In this case, the Master Control logs the transmission and gates the message back to BED.

c. This test may be repeated with the CDC SIFT.

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* Data of the type required by these tests is contained on Test 11 procedure and results.

1.16 Test 16

1.16.1 PROCEDURE

a. The purpose of this test is to insure reliable operation over many tests at high speed between Bedford and Hartford.

b. The Master Control transmits the callup list of Test 1, except that it simulates a reply to BEA (five-character message) and to WAC (ten-character message). The Master Control also allows two seconds for BED to reply to its calls.

c. SIFT is programmed to receive the BED calls only. It is also programmed to transmit on BED through the Master Control back to Bedford.

d. The Master Control originates a transmission schedule once each ten seconds beginning with RDBEA, and ten seconds later transmitting UBBEA, etc. The operator at Bedford visually inspects the READ during each ten-second transmission for the Bedford transmission, which should be about twenty characters long and containing a typical weather message.

e. This test should be run for fifteen minutes each hour for four hours a day, lasting about a week. The Bedford operator should carefully record all errors of transmission.

1.16.2 RESULTS

The period 9 March 1961 through 21 March 1961 was spent making arrangements for Test 16. During this period the Hartford end became inoperative and Bedford "SIFT" developed two malfunctions. The following troubles were located and corrected in "SIFT": Pin 16 on J22 (diode gates) was found open, and Q1 on J36 (synchronizing amplifier) was found to be "drifting". March 22, 1961 was spent checking all equipment on both ends to insure that everything was in operating condition. Since Test 16 was a Reliability-of-Equipment check, we did not want to start unless everything was operating normally. Test 16 was started on 23 March 1961, and it was concluded on 29 March 1961. (Refer to Test 16 Program Format for description of test.) During this period, approximately 9600 callups were recorded at Bedford. There was only one error, failure of "READ" to receive a message, and it was believed to be caused by an interrupted flow of data on the telephone line.

Test 16 Program Format

a. The Master Control sent the callup list of Test 2 with these additions: it simulated a reply from BEA (five-character message) and WAC (ten character message) calls; and it programmed two seconds for verification of BED replies.

b. Bedford was programmed to receive BED calls only, and to transmit on BED calls through the Master Control back to Bedford.

c. The Master Control originated a transmission schedule once each 24 seconds, beginning with RDBEA, and 24 seconds later transmitting UCBEA, etc.

d. Bedford was programmed to reply with a different callup word for each period of the day, followed by a typical weather message changed every day.

e. This test was run for over 15 minutes each hour for four hours a day, and lasted five days.

f. Since Bedford was to carefully record all errors, "READ" was wired direct to incoming line from Hartford so that any error could be easily detected.

First Day

Series No. 1

Callup List	Message Proper	End of Message
RDBEA RDBEA	ABCDE	Ltrs CR LF Fig S
RDBED RDBED	⊘15+ 48/23+4/023/WND LGY AN VRBL	Ltrs CR LF Fig S
RDWAC RDWAC	ABCDE 12345	Ltrs CR LF Fig S
RDAAC		Ltrs CR LF Fig S
RDABC		Ltrs CR LF Fig S
RDMMM		Ltrs CR LF Fig S
RDMAB		Ltrs CR LF Fig S
RDXYZ		Ltrs CR LF Fig S
RDCZA		Ltrs CR LF Fig S
RDCSS		Ltrs CR LF Fig S

RD through GE continually transmitted for approximately 19 minutes (47 BED calls).

Test 16 Program Format (Cont.)

First Day (Cont.)

Series No. 2 was the same as series No. 1 with one exception: in Bedford reply, the callup word was changed to UCBED. This series was run for 18.4 minutes (46 BED calls).

Series No. 3
a. Bedford callup word changed to MBBED
b. Same message
c. 47 BED calls

Series No. 4
a. Bedford reply changed to OABED; same message
b. 47 BED calls

Second Day

Series No. 5
a. Bedford message read:
RDBED 150015 36/22WSW 7+16/925/CU
b. 48 BED calls

Series No. 6
a. Bedford reply changed to UCBED, same message
b. 48 BED calls

Series No. 7
a. Bedford reply changed to MBBED; same message
b. 48 BED calls

Series No. 8
a. Bedford reply changed to OABED; same message
b. 48 BED calls

Third Day

Series No. 9
a. Bedford message read:
RDBED 100 0/0 15+ 41/19→3/001
b. 48 BED calls

Series No. 10
a. Bedford reply changed to UCBED; same message
b. 48 BED calls

Series No. 11
a. Bedford reply changed to MBBED; same message
b. 48 BED calls

Series No. 12
a. Bedford reply changed to OABED; same message
b. 48 BED calls

Fourth Day

Series No. 13
a. Bedford message read:
RDBED 10 0 18 0 7 39/32 Calm/29.82 BINOVC
b. 48 BED calls

Test 16 Program Format (Cont.)

Series No. 14	a. Bedford reply changed to UCBED; same message
	b. 48 BED calls
Series No. 15	a. Bedford reply changed to MBBED; same message
	b. 48 BED calls
Series No. 16	a. Bedford reply changed to OABED; same message
	b. 44 BED calls
Fifth Day	
Series No. 17	a. Bedford message read:
	RDBED M2806008 10 41/20→12+17/29.66
	VSBY LWR EAST
	b. 44 BED calls
Series No. 18	a. Bedford reply changed to UCBED; same message
	b. 48 BED calls
Series No. 19	a. Bedford reply changed to MBBED; same message
	b. 48 BED calls
Series No. 20	a. Bedford reply changed to OABED; same message
	b. 48 BED calls

1.17 Test 17

1.17.1 PROCEDURE

a. This test will allow an operator to utilize the TMT-1, in conjunction with other test equipment, in a subsystem test.

b. An operator is given a set of conditions representing a complete meteorological description at Bedford for insertion on the TMT-1 each five minutes. These conditions are fictionary and are designed to represent changing conditions. (See Test 2.) The operator must set the TMT-1 to the correct switch positions. Also, imaginary scan conditions are tabulated for each minute.

c. The Master Control sends a call list in any manner so long as Bedford is called on each five minutes with OABED and on each other minute with FABED (FABED is the scan callup for this test). The operators should synchronize their watches to within five seconds. The Master Control must verify a proper reply of OA or FA, as required, and gate the message back to Bedford, where it will be verified for correctness.

d. This test should be conducted for 3 to 5 days, 4 to 5 hours per day, one

hour "on" and one hour "off".

e. If the operator of the TMT-1 is not able to change the message data fast enough to properly transmit the data, the time durations in step 1 above may be changed to ten minutes per OA message and two minutes per FA message.

1.17.2 RESULTS

Testing was halted temporarily during the period of 23 March 1961 through 23 April 1961 due to contractual problems at Hartford. During this period both ends prepared for Test 17. (Refer to Test 17 Program Format for description of test.) Since the message proper was to be changed on the AN/TMT-1 between each transmission, Bedford requested that Hartford program three minute delay callup words. This allowed the AN/TMT-1 operator sufficient time for message change, and time to re-check the new message to eliminate the possibility of human error.

Test 17 was started on 24 April 1961, but after the fifth hour of operation "READ" developed a timing problem and would not function properly. On the sixth hour, Bedford applied Whippet, AN/GMH-2, in place of "READ". Whippet worked well until the eleventh hour, at which time the preheater burned out.* The preheater was inoperative during the eleventh and twelfth hours. The timing problem in "READ" was corrected and for the thirteenth hour, Bedford again utilized "READ" as the receiver. "READ"** again developed a malfunction during the fifteenth hour and Bedford switched over to Whippet for completion of test. During fifteen hours of testing, the only errors recorded by Bedford were caused by the malfunctioning of "READ".

Test 17 Program Format

This test was run for 15 one-hour periods.

Test 17 went as follows:

a. Hartford programmed to transmit a callup word every three minutes starting with OABED and repeating OABED every fifteen minutes, with FABED every three minutes in between.

b. Bedford was programmed to transmit and receive on all FA and OA calls.

c. A weather scan was then simulated by changing the message proper on the AN/TMT-1 every three minutes.

* The preheater has been redesigned to prevent rapid burn-out.

** This problem in READ has been analyzed and does not appear to exist in the service-test READ.

Test 17 Program Format (Cont.)

d. Every three minutes the AN/TMT-1 was called on to transmit and the Master Control then looped this information back to Bedford, through SIFT, and was printed out on the AN/TMH-1 (READ).

Callup List	Message Proper			End of Message
OABED OABED	0000M18●90●7	38/34½8	29.86/50204 15 90403 39	Ltrs CR LF Fig S
FABED FABED	0003 18●M60●7	38/34 8	29.86	Ltrs CR LF Fig S
FABED FABED	0006 M60●7	38/34 8	29.86	Ltrs CR LF Fig S
FABED FABED	0009 M60●7	38/35 Calm	29.86/102 15XX	Ltrs CR LF Fig S
FABED FABED	0012 M23●60●7	38/35 Calm	29.86	Ltrs CR LF Fig S
OABED OABED	0015 250M38●5GF	38/35 Calm	29.86/F1B1	Ltrs CR LF Fig S
FABED FABED	0018 M38●5GF	37/35 Calm	29.86	Ltrs CR LF Fig S
FABED FABED	0021 M38●5R--GF	37/35 Calm	29.86	Ltrs CR LF Fig S
FABED FABED	0024 M35●5R--GF	37/35 Calm	29.92	Ltrs CR LF Fig S
FABED FABED	0027 -XM25●3R--GF	37/35 Calm	29.93	Ltrs CR LF Fig S
OABED OABED	0030 -XM25●2R--GF	37/35 Calm	29.93/F2	Ltrs CR LF Fig S
FABED FABED	0033 -XM25●2GF	37/35 Calm	29.93/F2/32200 15XX 90404 36	Ltrs CR LF Fig S
FABED FABED	0036 -XM25●1GF	37/35 Calm	29.93/F2	Ltrs CR LF Fig S
FABED FABED	0039 -XM25●1R--GF	37/36 Calm	29.91/F5	Ltrs CR LF Fig S
FABED FABED	0042 -XM25● 7/8R--GF	37/36 Calm	29.91/F5	Ltrs CR LF Fig S
OABED OABED	0045 -XM25● 7/8R--GF	38/36 Calm	29.92/F5/50251 17XX 30534 30676	Ltrs CR LF Fig S
FABED FABED	0048 -XM25● 7/8F	38/36 Calm	29.89/F7	Ltrs CR LF Fig S
FABED FABED	0051 -XM25● 7/8F	39/37 Calm	29.89/F7	Ltrs CR LF Fig S
FABED FABED	0054 -XM25● 1 1/4F	39/37 F Calm	29.89/F7	Ltrs CR LF Fig S
FABED FABED	0057 -XM23● 1 1/4F	40/38 Calm	29.80/F6	Ltrs CR LF Fig S

1.18 Test 50:* Improper Response to Callup

The Master Control is monitored to determine if an accurate log is kept of all errors transmitted by the TMT-1. The Master Control sends out the callup OABED once each minute beginning at a predetermined time, after Bedford has synchronized time to nearest second. The OABED call will turn on the TMT-1 which will reply alternately with the following message headings, each followed by a space and message:

RABED	-1 Character Difference	2 Bits Difference
UABED	-1	5
OABAD	-1	1
OABVD	-1	5
OJDED	-2	2
OHIED	-2	9
OADAD	-2	2
OAIAD	-2	6

1.19 Test 51: No Response to Callup

Since Test 2 obtained the necessary data for this test, no performance is required. The data will, however, be noted under Test 2.

1.20 Test 52: Interrupted Transmission

1.20.1 PROCEDURE

a. When operating at 75 baud, approximately 75 baud equals about 7.5 seconds elapse between the start and E.O.M. of a 72-character message.

b. Before the start of the test, the operator at Bedford will synchronize his watch to the nearest second with that of Hartford operator (and, in turn, the Master Control). Within 0.5 seconds of the beginning of each minute, the Master Control will request BED to transmit. Four seconds after the beginning of the minute, the operator will switch the TMT-1 out of the circuit and break the message.

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* Tests numbered fifty and above were designed especially to test the Master Control equipment, Control Monitor C-2539. Although time did not permit the performance of these test, they have been included for purpose of reference and completeness.

c. The test will be run for 15 minutes and the log will be checked for accuracy.

d. The Bedford operator may use the light indicator on the TMT-1 as aid in judging this timing.

1.21 Test 53: Unterminated Transmissions

1.21.1 PROCEDURE

a. The Master Control will send OABED. A long message will be punched on tape (may be all one character) and transmitted by means of a tape reader. The message will be 100 characters long, and the Master Control programmed to accept a maximum of an 80-character message.

b. If the Master Control detects an unterminated transmission, it will send the callup CABED down the line to Bedford and this will be indicated on a teletypewriter.

c. Upon termination of the 100-character message, the Master Control will repeat the callup after a one-minute delay. This procedure will be performed for 15 minutes.

1.22 Test 54

1.22.1 PROCEDURE

a. The Master Control will demonstrate ability to adhere to a predetermined schedule.

b. The Master Control will request transmission of a low priority report schedule. This schedule will be that of Test 1 and will be transmitted, with only Bedford answering. The process one report schedule will be such to require interruption of this low priority schedule for transmission of a high priority report schedule. The high priority schedule will be a single message from the TMT-1. The program will be written such that enough time will remain for the completion of the low priority schedule after the high priority transmission.

1.23 Test 55

This test is the same as Test 54, except that the program time will not allow for the completion of the deferred low priority schedule. In this case, the low priority schedule will not be resumed.

1.24 Test 56

1.24.1 PROCEDURE

a. The time delay between receipt by the Master Control of one message from the Bedford station and the callup of the Master Control transmission of the next will be measured. Both callups will be in a report schedule as follows: OABED, RDBED, OABED (Repeat). Time will be subtracted for the line delay.

b. The Bedford operator will make the measurement, using a scope to measure the delay between the trailing edge of one message's final character, and the first character of the next callup. The delay shall not exceed 3-1/3 millisecond.

1.25 Test 57

At one-minute intervals and for 15 minutes, the Master Control will transmit the time, a line feed, a carriage return and an E.O.M. designator. This data will be transmitted and received, the log being the teletype receiver record.

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